



CHEMISTRY

0620/41

Paper 4 Theory Extended

May/June 2017

MARK SCHEME

Maximum Mark: 80

Published

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This document consists of **7** printed pages.

Question	Answer	Marks																				
1(a)	<i>proton number</i> : the number of protons	1																				
	<i>nucleon number</i> : the total number of protons and neutrons	1																				
	<i>nucleon number</i> : in the nucleus / nuclei (of an atom)	1																				
1(b)	(hydrogen is the only atom to have) no neutrons	1																				
1(c)	<table border="1"> <thead> <tr> <th></th> <th>number of protons</th> <th>number of neutrons</th> <th>number of electrons</th> </tr> </thead> <tbody> <tr> <td>¹⁹F</td> <td>9</td> <td>10</td> <td>9</td> </tr> <tr> <td>²⁶Mg</td> <td>12</td> <td>14</td> <td>12</td> </tr> <tr> <td>³¹P³⁻</td> <td>15</td> <td>16</td> <td>18</td> </tr> <tr> <td>⁸⁷Sr²⁺</td> <td>38</td> <td>49</td> <td>36</td> </tr> </tbody> </table>		number of protons	number of neutrons	number of electrons	¹⁹ F	9	10	9	²⁶ Mg	12	14	12	³¹ P ³⁻	15	16	18	⁸⁷ Sr ²⁺	38	49	36	
		number of protons	number of neutrons	number of electrons																		
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	²⁶ Mg	12	14	12																		
	³¹ P ³⁻	15	16	18																		
	⁸⁷ Sr ²⁺	38	49	36																		
	fluorine protons AND neutrons correct	1																				
	magnesium neutrons AND electrons correct	1																				
phosphorus protons AND neutrons correct	1																					
phosphorus electrons correct	1																					
strontium protons AND neutrons correct	1																					
strontium electrons correct	1																					
1(d)(i)	MgF ₂	1																				
1(d)(ii)	Sr ₃ P ₂	1																				

Question	Answer	Marks
2(a)(i)	SO ₂	1
2(a)(ii)	Na ₂ O	1
2(a)(iii)	Cr ₂ O ₃	1
2(a)(iv)	SiO ₂	1
2(a)(v)	Al ₂ O ₃ /Cr ₂ O ₃	1
2(a)(vi)	CO	1
2(b)(i)	an amphoteric oxide will react with acids AND with bases	1
2(b)(ii)	a neutral oxide will not react with acids or with bases	1

Question	Answer	Marks
3(a)(i)	no (more) effervescence	1
3(a)(ii)	magnesium carbonate	1
3(a)(iii)	(a solution in which) no more solute will dissolve	1
	at that temperature	1
3(a)(iv)	the solubility decreases as the temperature decreases	1
3(b)(i)	moles of water = $2.52 / 18 = 0.14$ (mol)	1
3(b)(ii)	moles of anhydrous magnesium sulfate = 0.02 (mol)	1
3(b)(iii)	ratio = $0.02 / 0.02 : 0.14 / 0.02 = 1 : 7$	1

Question	Answer	Marks
3(b)(iv)	MgSO ₄ ·7H ₂ O M1 MgSO ₄ M2 rest of the formula correct	2
3(c)	mix and stir the two solutions	1
	filter (to obtain residue)	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1
3(d)	Pb ²⁺ (aq) + SO ₄ ²⁻ (aq) → PbSO ₄ (s) M1 correct species M2 correct state symbols	2

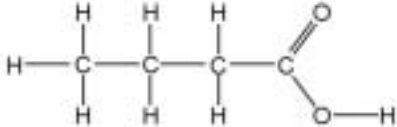
Question	Answer	Marks
4(a)(i)	roast in air	1
4(a)(ii)	2ZnS + 3O ₂ → 2ZnO + 2SO ₂ M1 correct species M2 correct balancing	2
4(b)(i)	coke	1
4(b)(ii)	zinc is vaporised / boiled	1
	and is condensed	1

Question	Answer	Marks
4(c)(i)	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ M1 correct species M2 correct balancing	2
4(c)(ii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ M1 correct species M2 correct balancing	2
4(c)(iii)	change: (the intensity would) decrease	1
	reason: the difference in reactivity between zinc and iron is less than the difference in reactivity between zinc and copper	1

Question	Answer	Marks
5(a)	(stop-) watch AND syringe	1
5(b)	graph starts at X and is a curve with a decreasing gradient	1
	graph hits zero rate at 114 ± 6 seconds	1
5(c)	M1 moles of carbon dioxide = $180/24\ 000 = 0.0075$	1
	M2 molar mass of barium carbonate = 197	1
	M3 mass of barium carbonate = M1 × M2 = 1.48 (g)	1
5(d)	curve starts from (0,0) and has a lower gradient than the original curve	1
	because lumps have a lower surface area	1

Question	Answer	Marks
5(e)	curve starts from (0,0) and has a steeper gradient than the original curve	1
	finishes at the same volume of gas	1
	because there are more particles per unit volume / $\text{dm}^3 / \text{cm}^3$	1
	because there are more collisions per second / unit time OR a greater collision rate	1
5(f)	360 (cm^3)	1

Question	Answer	Marks
6(a)	(compound that) contains carbon and hydrogen	1
	and no other elements / only	1
6(b)	any 3 from: <ul style="list-style-type: none"> • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation 	3
6(c)	propene	1
	structure correctly shown	1
6(d)	steam	1
	catalyst	1

Question	Answer	Marks
6(e)(i)	butanoic acid	1
		1
6(e)(ii)	acidified	1
	(potassium) manganate(VII)	1
6(e)(iii)	oxidation	1
6(f)	methanol	1
	ethanoic acid	1
	catalyst	1
	heat	1
	$\text{CH}_3\text{COOH} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O}$	1